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Title	Specification of operational environments for non-exclusively assigned and licensed bands	
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Re:	Working Group Review of Working Document IEEE 802.16h-06/015r1	
Abstract	This document contains additions to the P802.16h Working Document describing the operational environment for various bands of interest where 802.16 systems could operate in a non-exclusively licensed or assigned fashion, competing with other systems and technologies.	
Purpose	The purpose of this document is to establish a minimum set of common rules necessary for regulatory approval of 802.16 operation in certain bands while also documenting the peculiarities of the bands.	
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Specification of operational environments for non-exclusively assigned and licensed bands

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Overview

This document considers:

- In which bands would the coexistence methods developed in P802.16h be useful? Initially, this will consist of those bands for which the authors have sufficient information. It can be expanded to include other bands over time.
- For each band consider the operational parameters:
 - What is the frequency of allocation?
 - What is the bandwidth of allocation?
 - What are the channelization requirements?
 - What are the RF/antenna parameter limits for use of the band?
 - What is the licensing regime: exclusive assignment/licensing, non-exclusive assignment/ licensing, light licensing, or a combination?
 - Are there any other requirements imposed by the license regime?
- For each band consider the other potential occupants of the band:
 - What *Specific Spectrum Users* (SSUs) need to be detected and avoided in this band?
 - How should SSUs be detected and what is minimally required to not impact them?
 - What non-SSU technologies may be operating LE in this band?
 - What is the minimum recommended practice for coexistence with non-SSUs?
 - What are other coexistence recommendations beyond the minimums?

Specific editorial changes

This section provides a list of changes to the draft document.

Blue text represents specific editorial additions.

Red-strikethrough text is to be deleted.

Black text is text already in the draft.

Bold italic text is editorial instructions to the editor.

Add the following text and table to the end of Subclause 1.3.3:

A summary of some applicable bands is given in Annex B.

Change the following row in Table B.1 in subclause B.1:

	3.650-3.700	Rulemaking in progress	USA FCC Docket WT00-32 FCC-05-56
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Add the following row to Table B.1 in subclause B.1:

0.902-0.928 (license-exempt)	Open	USA FCC 47 CFR CH I (10-1-02 edition) CFR 15.247
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Add the following new subclause B.1.1

B.1.1 Operational environments for non-exclusively assigned and non-exclusively licensed bands

This subclause describes the operational environment for various bands of interest in which operation of an IEEE 802.16 system might require steps to ensure coexistence with other systems based on either IEEE 802.16 or other technologies. The purpose of this subclause is to provide guidance for regulatory approval of IEEE 802.16 operation in certain bands while also documenting the peculiarities of the bands.

A summary of applicable bands and features is given in Table xyz1 below..

Table xyz1: Summary of non-exclusively assigned and licensed bands of operation

Band	Operational requirement, including reference to relevant subclause	Additional features, including reference to relevant subclause
902 - 928 MHz [US band]		Coexistence with <i>Secondary Users</i> (6.4.2.3) <i>Coordinated</i> operation (15)
2400 - 2483.5 MHz [US band]		Coexistence with <i>Secondary Users</i> (6.4.2.3) <i>Coordinated</i> operation (15)
3650 - 3700 GHz [US band]	UCP (6.4.2.4)	Coexistence with <i>Secondary Users</i> (6.4.2.3) <i>Coordinated</i> operation (15)
5150 - 5850 MHz [Parts of U-NII bands in the US]	DFS (6.4.2.2)	Coexistence with <i>Secondary Users</i> (6.4.2.3) <i>Coordinated</i> operation (15)

5725 - 5850 MHz [UK band]	DFS (6.4.2.2)	Coexistence with <i>Secondary Users</i> (6.4.2.3) <i>Coordinated operation</i> (15)
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Other features in subclause 6.4.1 may be used for operation in non-exclusively assigned and non-exclusively licensed bands.

B.1.1.1 902 - 928 MHz in the US

The USA rules, including power levels, for this band are contained in FCC 47 CFR CH. I (10-1-02 Edition) CFR 15.247. It provides 26 MHz of spectrum for licensed-exempt use. There are no channelization requirements.

This band has no SSUs.

This band is currently heavily used by cordless telephones and some other data equipment.

For point-to-multipoint operation, radiated power is reduced by the amount that directional antenna exceeds 6 dBi (and applying the limits and measurement requirements in section 15.247(b)(1)-(3)).

Coexistence mechanisms in 6.4.2.3 and Clause 15 may be applicable.

B.1.1.2 2400 - 2483.5 MHz in the US

The USA rules, including power levels, for this band are contained in FCC 47 CFR CH. I (10-1-02 Edition) CFR 15.247. The rules provide 83.5 MHz of spectrum for licensed-exempt use. There are no channelization requirements.

This band has no SSUs.

This band is currently used by many systems including IEEE 802.11, IEEE 802.15 and cordless telephones. In addition, this band contains “unintelligent” radiators such as microwave ovens. IEEE 802.11 systems use a 20 MHz channelization but define the channels to overlap with 5 MHz carrier center frequency spacing.

Coexistence mechanisms in 6.4.2.3 and Clause 15 may be applicable.

B.1.1.3 3650 - 3700 MHz in the US

The FCC rules for this band are contained in 47 CFR, Part 90 (“Private Land Mobile Radio Services”). This provides 50 MHz of spectrum from 3.65 GHz to 3.70 GHz. It is licensed under a non-exclusive, nationwide basis for the entire 50 MHz. There are no channelization requirements. The power levels specified for this band are contained in 47 CFR 90.1321, which specifies 25W peak EIRP/25 MHz for fixed stations and 1W peak EIRP/25 MHz for mobile and nomadic stations. The emission masks are specified in 47 CFR 90.1323.

The regulations do not specify channelization requirements. However, for effective DCS, 802.16 systems operating in this band should use either 5 or 10 MHz non-overlapping channels (*note: normative statement*).

Two different types of specific spectrum users exist in this band – Fixed Satellite Service (FSS) earth stations and three government operated radiolocation sites. These are protected through exclusion zones mandated in 47 CFR 90.1331, which provides for 150 km exclusion zones around the FSS stations and 80 km exclusion zones around the government radiolocation sites. Additional restrictions are placed on operation near the USA/Mexico border and the USA/Canada border. To ensure adherence to the exclusion zones, and to monitor the number of stations deployed under the non-exclusive licenses, fixed stations (both BS and SS) must have their location registered. Mobile stations (both BS and SS) are permitted to transmit only if they can hear and properly decode the downlink from a fixed base station. Operation within an exclusion zone is possible through coordination with and permission from the FSS operator. Outside of the exclusion zones, there are no SSUs, so there is no direct requirement for DFS in this band.

It is likely that an IEEE 802.16 system in this band will face the need to coexist with other 802.16 systems. Non-802.16 systems will likely be present as well. In particular, the IEEE P802.11y project is developing an amendment to specifically address the changes necessary for IEEE 802.11 systems to operate in this band. The presence of other systems suggests the use of coexistence mechanisms, such as DCS to select the best channel for operation.

In 47 CFR 90.1319, the FCC requires the use of a contention-based protocol in the 3.65-3.7 GHz band. In order to satisfy this requirement and to coexist with 802.11 systems and other 802.16 systems, 802.16 systems operating in this band should use the uncoordinated coexistence protocol defined in section 6.4.2.4, including the DCS, extended adaptive quiet periods, and listen-before-talk features (*note: normative statement*).

Industry Canada has indicated that the rules for this band in Canada will be similar to those established by the FCC.

B.1.1.4 5725-5850 MHz in the UK

The minimum equipment requirements for operation within the UK in the band 5725-5850 MHz are given in *UK Radio Interface Requirement 2007: Fixed Broadband Services operating in the frequency range 5725-5850 MHz* (Version 1.00).

The services deployed in the band are fixed with a max EIRP of 2W with a PSD not exceeding 100mW/MHz. There are also restrictions of power transmission in the elevation plane. The duplex is TDD with no channelization requirements. DFS and TPC are mandated in this band. DFS is a specific realization concerning the identification and avoidance of SSUs. In this band, the SSUs are radar signals. The requirements say:

Equipment operating in this band must implement a random channel access mechanism capable of operating across all of the frequency range. Shall prevent co-channel operation in the presence of Radar signals. The DFS detection threshold shall be based upon:

- *-67 dBm for devices with EIRP greater than 1W,*
- *-64 dBm for devices from 200mW to 1W EIRP,*
- *-62 dBm for devices with EIRP less than 200mW.*

These thresholds represent the levels at the output of the antenna and are normalised to 0dBi antenna gain. For devices with a higher gain the threshold may be increased by 1dB for each dB of antenna gain.

Transmit Power Control (TPC) shall be employed with a dynamic range of at least 19dB relative to the maximum EIRP allowed. Stations with a maximum EIRP capability lower than the maximum allowed EIRP can reduce the TPC range accordingly.

B.1.1.5 Middle, WRC, and Upper U-NII Bands in the US

The Unlicensed National Information Infrastructure (U-NII) bands have the following major frequency bands:

- *Lower U-NII (5150 - 5250 MHz),*
- *Middle U-NII (5250 - 5350 MHz),*
- *WRC (5470 - 5725 MHz),*
- *Upper U-NII / ISM band (5725 - 5850 MHz).*

IEEE 802.11a systems are widely operated in the *Lower* and *Middle U-NII* bands. The *Lower U-NII* band requires use of an integrated antenna and is intended for indoor use, while the *Middle U-NII* band allows for a user installable antenna. The 5470-5725 MHz band provides for both outdoor and indoor use. Deployments in the *Upper U-NII* (5725 to 5850 MHz) band are for outdoor deployment power allowances are in the 2 to 4W range as

compared to only 1W in the *Lower* and *Middle U-NII* bands. Many Wireless Internet service providers use 5725 - 5825 MHz. Sometimes this band is referred to as UNII/ISM due to regulatory overlap with the ISM band. Regulations allow for a user-installable antenna.

U-NII is an FCC regulatory domain for 5 GHz wireless devices. U-NII power limits are defined by the US CFR Title 47 (Telecommunication), Part 15 - Radio Frequency Devices, Subpart E - Unlicensed National Information Infrastructure Devices, Paragraph 15.407 - General technical requirements.

DFS (radar detection function) for U-NII devices operating in the *Middle U-NII* (5250 - 5350 MHz) and *WRC* (5.470 - 5725 MHz) bands are required to detect the presence of radar systems (SSUs) and to avoid co-channel operation with radar systems (SSUs). The minimum DFS detection threshold for devices depends on the EIRP of devices operating in the band.

Operation in this band should use coexistence with *Secondary Users* (6.4.2.3) or *Coordinated* operation (15) to find the best channel on which to operate (*note: normative statement*).

Add the following definition to clause 4: ‘Abbreviations and Acronyms’

TPC	Transmit Power Control
U-NII	Unlicensed National Information Infrastructure
WRC	World Radio Conference

Add the following definition to Annex A: ‘Bibliography’

(US) Federal Communications Commission, *FCC-05-56, Report and Order and Memorandum Opinion and Order in the matter of Wireless Operations in the 3650-3700 Band*, March 2005
<http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-56A1.pdf>.

Industry Canada, DGTP-006-06, *Proposed Spectrum Utilization Policy, Technical Licensing Requirements for Wireless Broadband Services (WBS) in the Band 3650-3700 MHz*, August 2006.

(UK) Office of Communications (Ofcom), *UK Radio Interface Requirement 2007: Fixed Broadband Services operating in the frequency range 5725-5850 MHz* (Version 1.00), December 2003,
<http://www.ofcom.org.uk/radiocomms/ifi/tech/interface_req/uk_interface_2007.pdf>.

References

[1] IEEE 802.16h-06/015r1: *Air Interface for Fixed Broadband Wireless Access Systems: Amendment for Improved Coexistence Mechanisms for License-Exempt Operation*, Working Document.

[2] IEEE 802.16h-06/012r1: *Comments received in Working Group Review of Working Document IEEE 802.16h-06/010*.

[3] (US) Federal Communications Commission, *FCC-05-56, Report and Order and Memorandum Opinion and Order in the matter of Wireless Operations in the 3650-3700 Band*, March 2005
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[4] Industry Canada, DGTP-006-06, *Proposed Spectrum Utilization Policy, Technical Licensing Requirements for Wireless Broadband Services (WBS) in the Band 3650-3700 MHz*, August 2006.

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